DOCUMENT RESUME

ED 097 406 UD 014 595

AUTHOR Brown, Edward K.
TITLE Cognitive Mechanisms of Children Exhibiting Learning Disabilities.
PUB DATE 31 Oct 74
NOTE 40p.; Paper presented at the International Symposium on Learning Disabilities (Miami Beach, Florida, October 1974)

EDRS PRICE MF-$0.75 HC-$1.85 PLUS POSTAGE
DESCRIPTORS Basic Skills; Cognitive Development; *Cognitive Processes; Cognitive Tests; Educational Theories; *Junior High School Students; *Learning Disabilities; *Learning Processes; Learning Theories; *Models; Multiple Regression Analysis; Research Methodology; Statistical Analysis

ABSTRACT

Although a lot of data on the psychological characteristics of children having learning disabilities have been gathered, not very much has been done to discover the underlying mechanisms, processes, or phenomenon of learning disability. Without more investigations which attempt to get at these, we will continue to be at a loss to prescribe effective methods for improving the health, education, employment opportunity, and social health of these children. A homomorphic psychometric model has been proposed to show the integrative functions and relationships between and among psychometric measures of learning ability, aptitude, and/or achievement. If the proposed homomorphic psychometric model can be used to demonstrate interrelationships among psychometric measurements as do the cognitive structures of learning theorists and as do neuron during interfacilitation, then a systematic study of the distribution and interrelationships of such measures among high- and low-achieving children might offer insights into means by which each group proceeds to solve educational tasks. In a recent study an attempt was made to discover the differences between the cognitive functions of 109 high-and low-achieving eighth grade students. Six tests of cognitive ability and eight subtests of the Iowa Tests of Basic Skills were used in the analyses. (Author/JM)

BEST COPY AVAILABLE

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

ED 097406

COGNITIVE MECHANISMS OF CHILDREN EXHIBITING LEARNING DISABILITIES

EDWARD K. BROWN

Instructional Research & Development Services

The School District of Philadelphia

A paper for the International Symposium on Learning Disabilities

Miami Beach, Florida

October 31, 1974

UD 014 [illegible]

TABLE OF CONTENTS

	Page
Abstract	i
Introduction	1
The Problem	2
Understanding the Phenomenon	3
Homomorphic Psychometric Model	5
A Case Study	9
Cognitive Facilitating Engram	18
Performance Engrams of High Achievers	24
Performance Engrams of Low Achievers	25
Implications for Children Exhibiting A Learning Disability	27
Factor 1. Physiological Constraints	29
Factor 2. Psychological Constraints	29
Factor 3. Educational Constraints	30
Recommendations for Instructional Programs	30
References	32
Appendix	34

COGNITIVE MECHANISMS OF CHILDREN EXHIBITING LEARNING DISABILITIES

EDWARD K. BROWN

Instructional Research and Development Services

Office of Research and Evaluation

School District of Philadelphia

Children exhibiting learning disabilities are children who are not able, for a variety of reasons, to make the necessary connections between what they know and what the schools expect them to be able to accomplish. They are children who do not respond to the cues, signals, practices, and reinforcements provided in a regular educational setting. They are children whose experiences have caused them to develop patterns of depression, suspicion, and isolation. They have also learned how to ignore stimuli, both internal and external, which would upset or threaten their preceived feeling of personal security (homeostasis).

Typically, children exhibiting learning disabilities are alert, friendly, and successful when they are performing concrete tasks. Socially, however, they tend to be anxious, disruptive, and immature. A majority of them would manifest poor motor-visual corrdination and poor visual discrimination. About one-third of them would show signs of having a short attention/memory span. About one-sixth of them could be diagnosed as either having minimal brain dysfunction or having mixed dominance (viz., confusion in coordinating appropriate hand and eye movements).

Estimates of their intellectual ability would show that one-half of the group would have Intelligence Quotients below 89 IQ points and half above 90

IQ points. (Note: Some definitions include only the latter.) In either case, the school performance of these children would be more than 1.5 years below grade level (Brown, 1974).

THE PROBLEM

Although a lot of data on the psychological characteristics of children having learning disabilities has been gathered, not very much has been done to discover the underlying mechanisms, processes, or phenomenon of learning disability. Most of the recent investigations has been aimed at (a) the refinement of screening instruments, (b) the determination of the factor structure of current tests, and (c) the ability of such tests to predict school success. These kinds of studies are important. However, they do not deal directly with the more fundamental problem: "What's interferring with the learning process and the expression of achievement of these children?" I firmly believe that without more investigations which attempt to get at these causes or phenomenon, we will continue to be at a loss to prescribe effective methods for improving the health, education, employment opportunity, and social health of these children.

UNDERSTANDING THE PHENOMENON

Where should we begin our investigation if we hope to find an answer? Let's start with the learning theorists and see what they have to say. Current learning theorists describe learning as a dynamic process. They think of learning as an on-going activity where stimuli are being categorized, catalogued, retrieved, and integrated to produce a desired response (output). Instead of the straight stimulus-response reactions, learning is thought of as a holistic process: the stimulus, cognitive activities, and response being a singular package. Therefore, heirarchies of learning exist wherein the simplist represents

something like the encoding activities; the most complex being inferential, divergent, or creative thinking. Examples of theories which support the structural processes of learning are "Learning Sets (Harlow and Gagné; 1959), Learning Episodes (Bruner, 1960)."

There have been efforts to categorize levels of knowledge, cognition, and the intellect. Three major works have evolved from these endeavors: Bloom (1966), Piaget (1952), and Guillford (1956). Bloom's Taxonomy of Educational Objectives represents a compendium of objectives which classify the outcomes of educational experiences. His hierarchy of outcomes range from the acquisition of specific facts (information) to the development of process of inductive judgment (without the aid of external information). Piaget's model has demonstrated how the assimulation of knowledge (intelligence) is related to the natural phenomenon of human development. The beginning stage of his continuum is called "preoperational" functions; those at the other end are "formal operations." According to Piaget, under normal circumstance the progress from simple to complex learning parallels the growth (developmental) phases of an individual. The mind and body grows together.

Guilford, through his Structure-of-Intellect model, has identified at least 104 independent, intellect factors. Although these factors follow a scale of complexity, Guilford chooses to define his system in terms of three standard parameters: Content, Operation, Product. Content categories are estimates of the contextual structure of the factor--Figural, Symbolic, Semantic, and Behavioral. Operation categories are those which define the activities of the factor--Evaluation, Convergent Production, Divergent Producation, Memory, and Cognition. Product categories are those functions which define the outcomes and/or configurations--Classes, Relations, Systems, Transformations, and Implications.

Within this structure of intellect, the least complex integral or factorial function is Figural-Units-Evaluation; the most complex being Behavioral-Cognition-Implication.

When we turn to the field of neurophysiology, we find that the studies of Hebb (1949) have shown that patterns of interneuronal networks can be associated with learning. Hebb cited four major neuronal configuarations: Constellations, assemblies, phases, and complex interfacilitation. The additional work of Luria (1966) and Beritashvili (1969) have refined and suplemented Hebb's work. The insights from their work have helped to clarify (a) the mechanism of neuronal interfacilitation, (b) the effects of neurophysiological functions on the establishment of neuronal pathways, and (c) the relationships between the disruptions of mental activities and brain lesions. This is not, of course to minimize the considerable contributions and constructive work achieved in the areas of neurochemistry and neuroanatomy. Indeed, many of the previously mentioned studies would not have been possible without the qualitative and quantitative studies of Pribram (1967), Krech (1968), Teitelbaum (1955), Hydén (1962), and others.

Collectively, these findings suggest that learning is a process which involves the integration of information from two sources--external sensory stimuli and internal excitatory outputs (i.e., forebrain, reticular formation). External sensory stimuli communicate information from the outside world and trigger a chain of additional reactions which call forth information stored within the brain. In the end, all stimuli merge to form an image, response, and/or action. However, not all of the effected neurons whose endings are related to or correlated with the outcome reach their optimal excitation level. These stimulations are either dissipated or shunted.

This action suggests that a stimulus must produce a defined set of associations within and among the neurons which comprise the final output/ or responses. Evidence concerning the contribution of different areas of the brain in the learning process has already been substantiated. White (1965), in his studies of the brain functions during learning, was able to demonstrate that the brain did not function as a singular unit during the learning process. He found (a) that different areas of the brain functioned at different times and (b) that the level of strength (amplitude) of the impulses also varied. By measuring the volt-potential at each of these points, he was able to determine the contribution of each area to the final output (impluse). From these data he was able to calculate correlation coefficients. Further information on the interactive mechanisms of brain functions during times of consciousness, awareness, learning, and control are presented in a recent publication by Scientific American: Altered States of Awareness. Other studies have shown that the brain tends to function in a binary fashion which is similar to that of a computer, where the emergent pattern (most frequently utilized) being the one having the greatest excitation probability.

These findings suggest that psychometric measures could also be used as tools for demonstrating the intercorrelate patterns of cognitive and educative abilities/skills during the learning process. That is, if psychometric measures truly measure the underlying psychological continuum of the assessed ability/ skill, then the studying of these patterns would give us (a) insights into which abilities/skills are associated with the attainment of specific tasks or (b) discover the differences in the ability/skill clusters of pupils demonstrating different achievement potentials.

A homomorphic psychomeytic model has been proposed by the author to show the integrative functions and relationships between and among psychometric

measures of learning ability, aptitude, and/or achievement (Brown, 1971). The analogues drawn between this model and learning theories, learning structures, intellect structures, and neuropsychological/neuroanatomical are shown in Table 1. Essentially, zero order correlations are analogous to the assemblies described by Hebb, the Level 1 functions of Jensen, the simple learning sets of Harlow and Gagné, the Cognitive-Figural-Unit structure of Guilford, the concrete thinking function of Bruner, and the concrete operational phase of Piaget. Accordingly, as one moves through muliple correlations, Unifactors, and multi-factors, he is moving through the higher levels of functions described by the cited theorists.

A pictorial representation of the homomorphic psychometric variables (x_1, x_2, x_3, x_4,) such as intelligence, aptitude, achievement is given in Figure 1. The initial points of interaction between these variables form zero order correlations (i.e., $r_{x1, x2}$). Where these variables' ties meet as a common, integrated function, they form a multiple correlation--$R_{1,2,3,4}$. When more than one integrated function interact to preform a more complex operation, a multiple factor is created. Likewise, as more and more functions merge, a more difuse network (centroids) is formulated.

If the proposed homomorphic psychometric model can be used to demonstrate interrelationships among psychometric measurements as do the cognitive structures of learning theorists and as do neuron during interfaciliation, then a systematic study of the distribution and interrelationships of such measures among high- and low-achieving children might offer insights into means by which each group proceed to solve educational tasks. The methods they use might be thought of a cognitive processing system, where the primary functions are the processing, retrieving, and analyzing of information.

TABLE 1

Analogues Among Neurological, Psychometric, and Psychological Hierarchies of Learning

Neuro-psychological (Hebb)	Homomorphic Psychometric (Brown)	(Jensen)	Learning Sets (Harlow & Gagne)	Structure of Intellect (Guilford)	Cognitive Domain (Bloom)	Learning Episodes (Bruner)	Cognitive Development (Piaget)
Constellations			Pre-requisite Abilities and Skills		Knowledge of Specifics	Basic Abilities and Skills	Preoperational
Assemblies	Zero Order Correlations	Level I	Simple Sets	CFU		Concrete Thinking	Concrete Operational
	Multiple Correlations	Level II					
Phases	Basic Factors						
Complex Inter-facilitation	Multiple Factors	Level (n)	Complex Sets	EBI	Judgments; External Criteria	Intuitive Thinking	Formal Operational

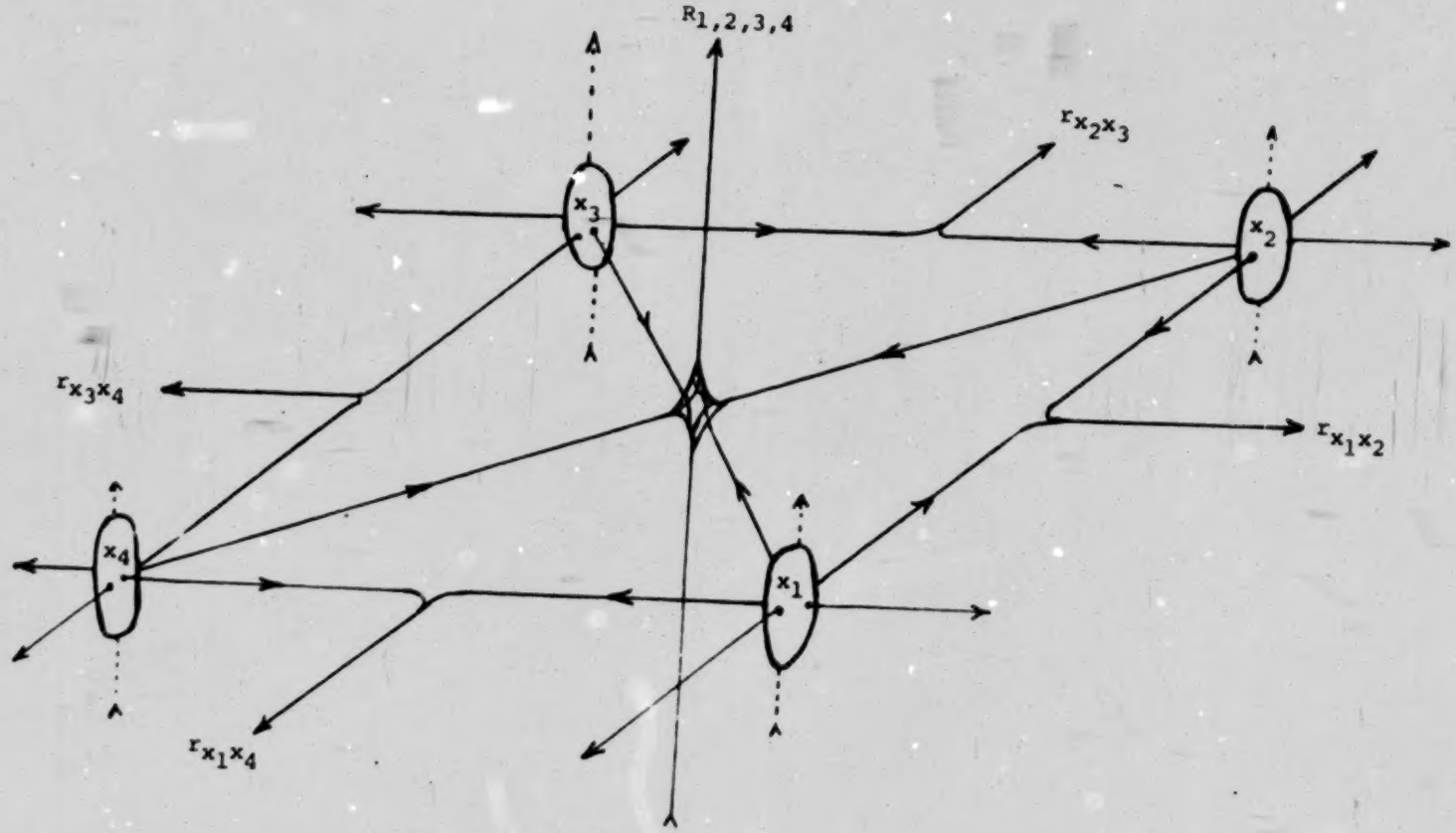


Figure 1. Pictorial representation of the integrative inputs/output functions of the proposed Homomorphic Psychometric Model (HPM).

BEST COPY AVAILABLE

Accordingly, it would appear that the correlation structure and inter-correlation patterns of the high-achieving children would represent those relationships as defined by the psychometric measures, which produce optimal achievement output. Similarly, the patterns of the low-achieving children would represent relationships which are less functional. Therefore, by studying the qualitative and quantitative differences between the two groups, one might discover not only how and why the cognitive processing systems differ, but also what might be done to improve the performance of low-achieving and/or learning disable child.

A CASE STUDY

In a recent study by the author an attempt was made to discover the differences between the cognitive functions of 109 high- and low-achieving eighth grade students (Brown, 1971). High achievers were students primarily from high- and middle-SES environments whose educational experiences, expressed as standardized test scores, indicated that they were more than one year above grade expectation. Low achievers were students primarily from low-SES environments whose educational experiences, expressed as standardized test scores, indicated that they were one or more years below grade expecation.

Six tests of cognitive ability (French, et al., 1963) and eight subtests of the Iowa Tests of Basic Skills were used in the analyses. (A detailed description of each test is given in the Appendix.) These tests were closely related to the measurement of reading and arithmetic achievement. The two groups' performance was significantly different ($p<.01$) on four of the six cognitive ability tests and four of the basic skills tests. (It should be noted that significance differences were observed on the other tests at the .05 level.) On the basic skills battery, the high achievers' average composite

BEST COPY AVAILABLE

score was 1.6 years abo grade level. The low achievers' average composite score was 1.8 years below grade level.

Zero order correlations. When the zero correlations of the two groups were plotted against Reading Comprehension, (Figure 2) and Arithmetic Problem Solving (Figure 3) tests, the resultant plots, called cognitive-educative integrates (CEI), were markedly different. In Figure 2 (page 11) we see that the CEI patterns are similar, but significant differences existed between the relationship of the criterion, reading comprehension, and six of the independent variables. In Figure 3 (page 12), comparisons of relationships with Arithmetic Problem Solving, we find that the CEI of the groups are qualitatively and quantitatively different, with the high achievers' correlations being much lower in all cases except Arithmetic Concepts (A-1).

Multiple Correlations. When applying a regression analysis procedure to determine which variables would best predict the reading and arithmetic performance of the two groups, another interesting result was achieved. The results are shown in Figures 4 and 5. It was found that the variables which best predicted the reading performance of high achievers were not those which predicted the performance of the low achievers. In Figure 4 (page 13), we see that the only variable the groups had in common was vocabulary (V). Another interesting finding was that the variables could explain considerably more of the variance of the low achievers (76%) than the high achievers (53%).

The reverse of this situation occurred when predicting arithmetic problem solving. Figure 5 (page 14) shows that with the exception of numerical Facility (N); the variables predicting the performance of the high achievers did not predict the performance of low achievers. Indeed, one would expect that Arithmetic Concepts (A-1) would play an important role in problem solving;

BEST COPY AVAILABLE

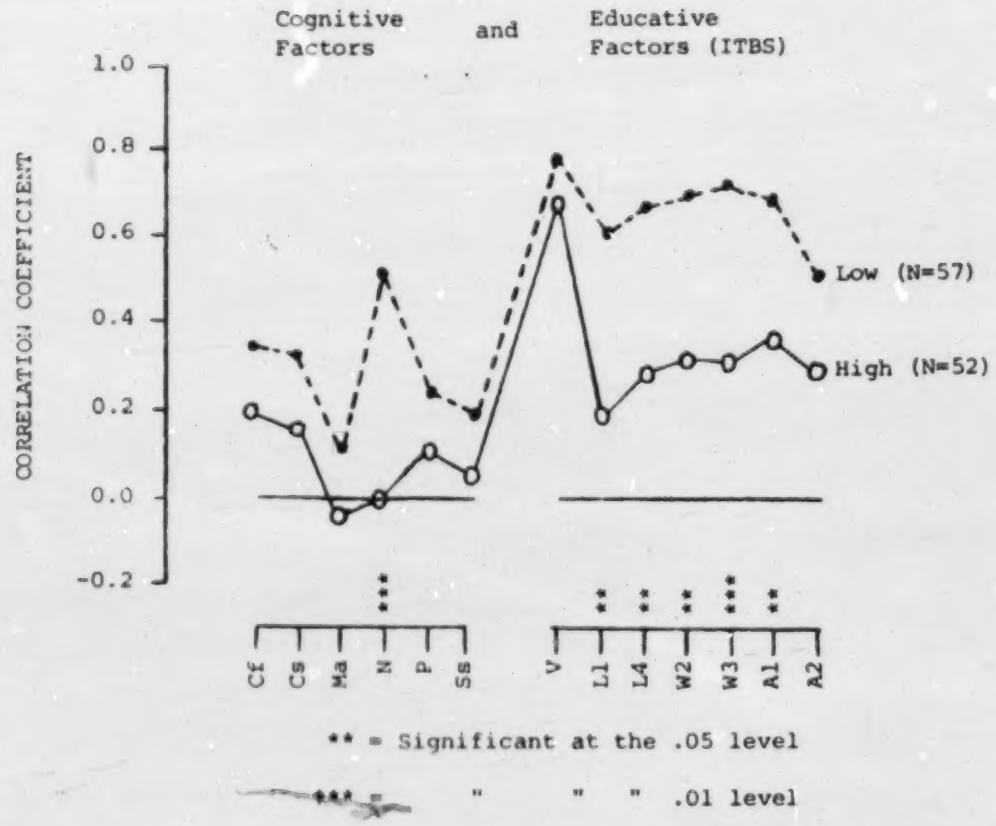


Figure 2. Reading comprehension CEIs of high- and low-achieving eighth-grade students.

BEST COPY AVAILABLE

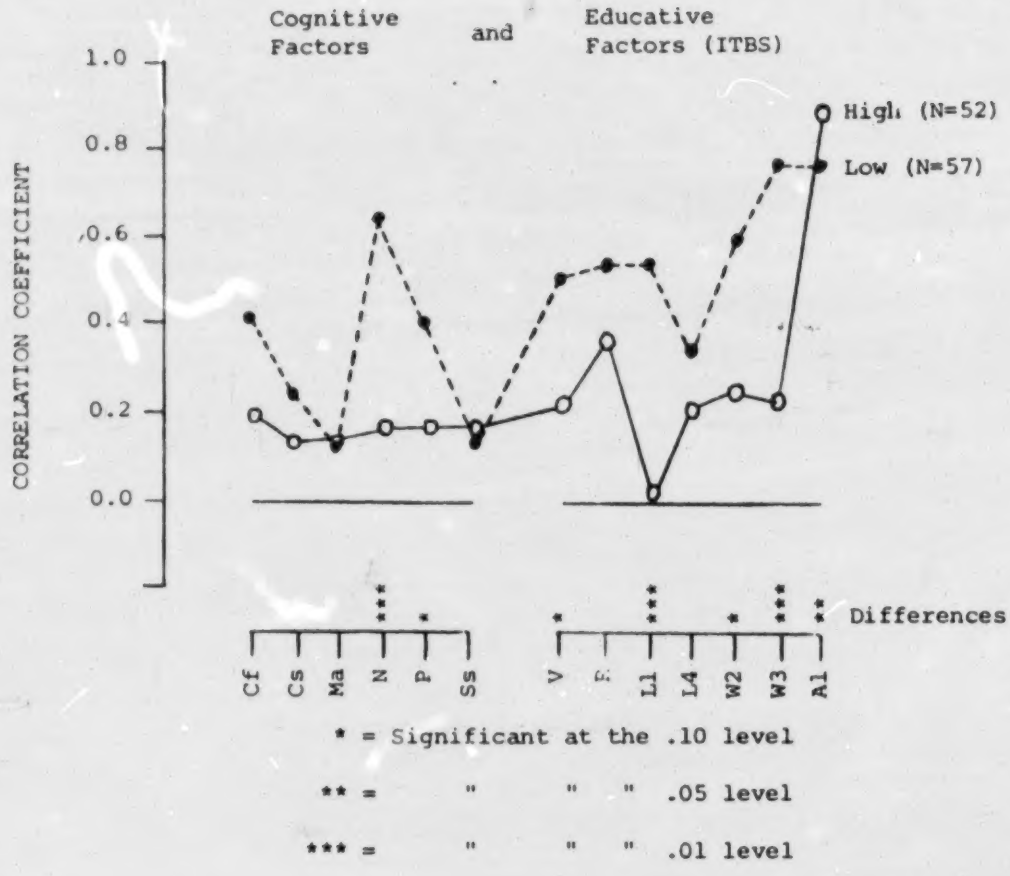


Figure 3. Arithmetic problem solving CEIS of high- and low-achieving eighth-grade students.

BEST COPY AVAILABLE

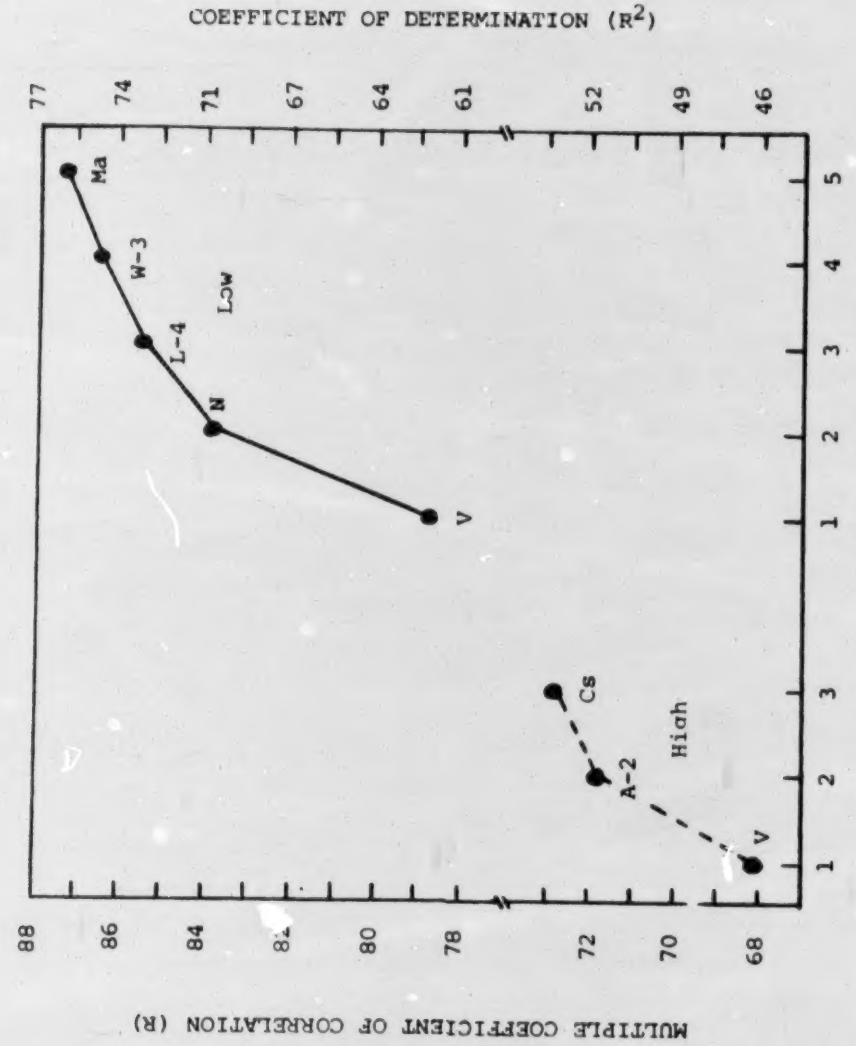


Figure 4. Significant contributors ($p < .05$) to the prediction of reading comprehension performance scores of high- and low-achieving eighth-grade students.

BEST COPY AVAILABLE

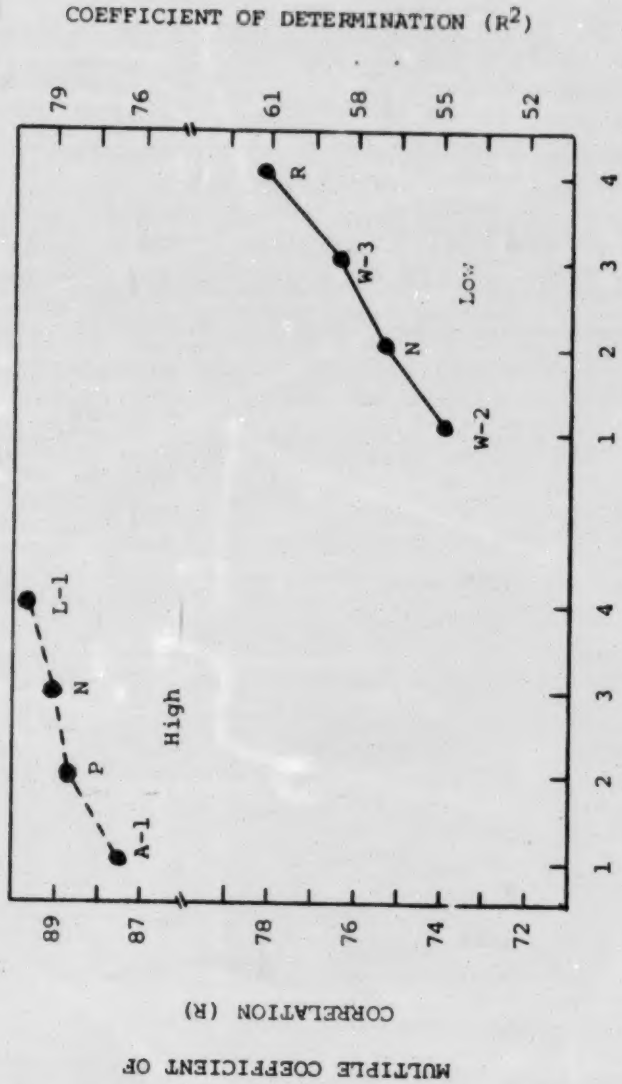


Figure 5. Significant contributors ($p<.05$) to the prediction of arithmetic problem solving performance scores of high- and low-achieving eighth-grade students.

however, the variable did not appear as a predictor of low achievers' performance. For low achievers, study skills operations (W-2, W-3) and reading were significant. In total, the predictors could explain up to 80% of the high achievers' performance and only 61% of the low achievers.

When determining the proportion of explained variance which could be attributed to cognitive and educative variables, it was found that educative variables did not appreciably improve the prediction of the low achievers' school achievement. In contrast, it was found that the high achievers' school achievement was highly related to those abilities and skills that are universally accepted as achievement predictors.

Factor structure. A factor analysis procedure was used to determine whether the tests were measuring the same psychological traits in the two groups. Initially, the combined sample was used to verify the two continua being studied. Figure 6 (page 15) shows the plot of the two factors on which the cognitive and educative variables had the highest loading (the general factors). As the plot indicates, the cognitive ability and educative (Iowa Tests of Basic Skills) tests formed two distinct (orthogonal) continua. On the cognitive the ability closest to the origin is Assocatie Memory (#7 or Ma-2); the farthest Speed of Closure (#6 or Cs-1). On the educative continuum, the distinction between verbal functions (#1, 2, and 11 or Reading, Language Usage, and Vocabulary) and non-verbal functions (#4 and 14 or Arithmetic Concepts and Problem Solving) is evident.

This picture markedly change when we look at the factor structures of the two groups. The structural factors for high achievers is shown in Figure 7 (page 17). Here we find two distinct bipolar configurations--one for arithmetic, (#4 and #14), one for reading (#1 and #11). All other variables have clustered

BEST COPY AVAILABLE

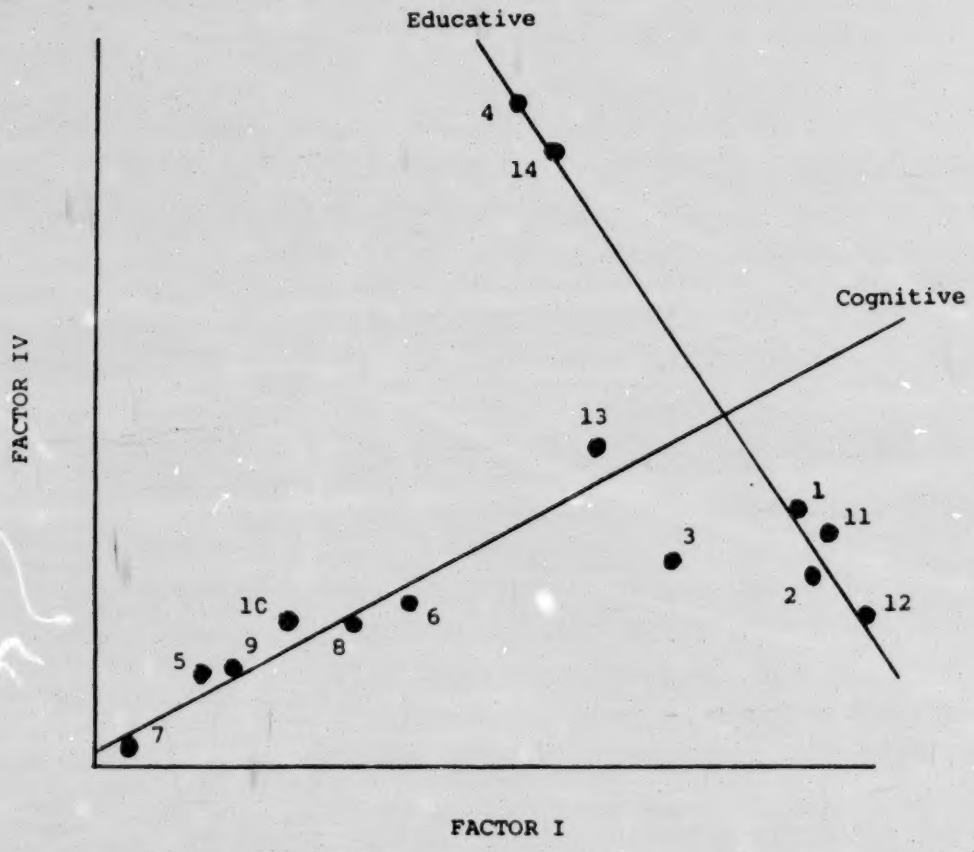


Figure 6. Factor clusters of six cognitive and eight educative skills (Iowa Tests of Basic Skills) - combined samples.

Variables: 1=R, 2=L-1, 3=W-2, 4=A-2, 5=Cf-2, 6=Cs-1, 7=Ma-2, 8=N-3, 9=P-3, 10=Ss-1, 11=V, 12=L-4, 13=W-3, 14=A-1

BEST COPY AVAILABLE

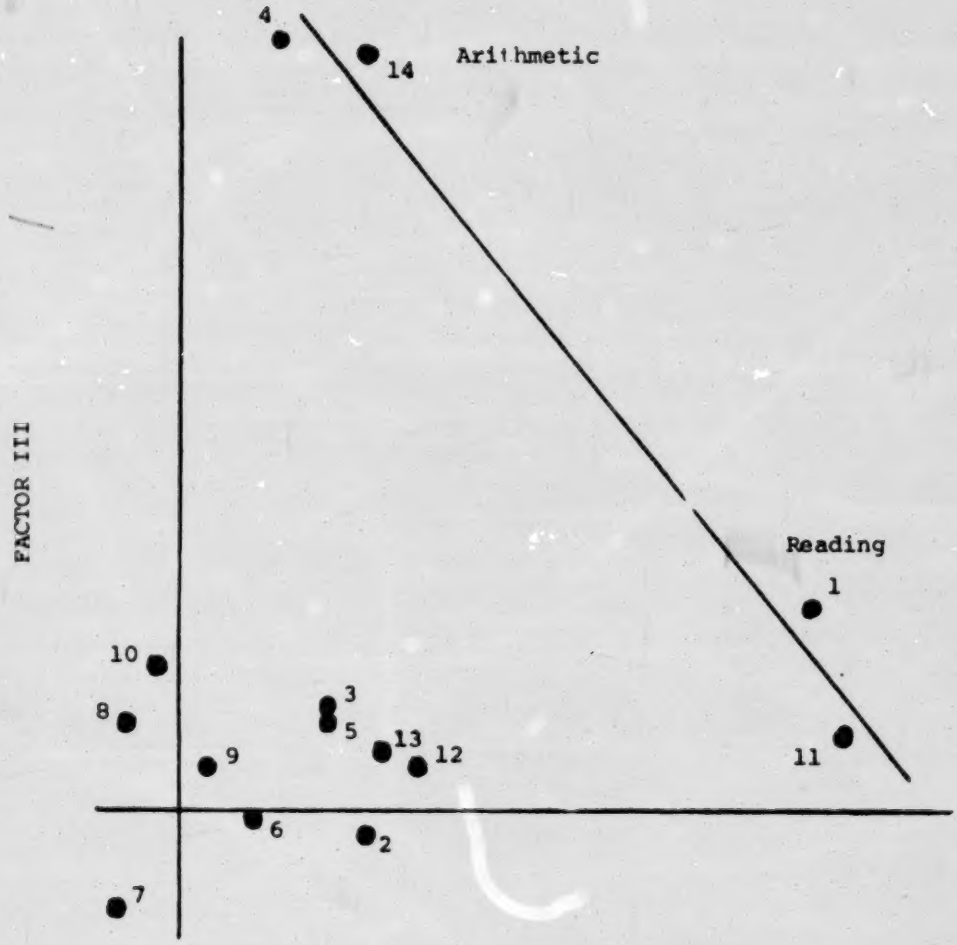


Figure 7. Factor clusters of six cognitive and eight educative skills (Iowa Tests of Basic Skills) - high achievers.

Variables: 1=R, 2=L-1, 3=W-2, 4=A-2, 5=Cf-2, 6=Cs-1, 7=Ma-2, 8=N-3, 9=P-3, 10=Ss-1, 11=V, 12=L-4, 13=W-3, 14=A-1.

BEST COPY AVAILABLE

around the origin. This strongly suggests that the reading and arithmetic operations are well defined and differentiated from the other operations.

Figure 8 (page 19) shows the structural factors of the low achievers. The first thing we notice is that the two continua have not been differentiated. Second, we find that their reading and arithmetic operations are confounded. Included in their reading operations are language usage (#2, spelling) and study skills (#3, Reading Graph & Tables) functions. In a similar manner, their arithmetic operations has a cognitive function (#8, Numerical Facility) and a study skills function (#3, Knowledge and Use of Reference Materials). The inclusion of these functions in the major operations strongly suggest that the processes learned in these allied functions are being used to carry out the intended activities. Stated differently, a unique cognitive processing system has been substituted for the more optimal system.

COGNITIVE FACILITATING ENGRAM

The findings of this study suggested that low achievers exhibited a poor quality of achievement because they retrieved and integrated inappropriate bits of information into an ineffective cognitive processing system. That is, their cognitive processing system represented unique methods for analyzing and/or solving problems which were derived from a sophisticated use of cognitive ability factors rather than a sequential arrangement of prescribed educative activities that have been proven historically to be highly reliable (Brown, 1971, p.34).

Obviously, the eighth-grade students in the aforementioned study had developed inefficient cognitive processing system. Through a variety of factors (before, during, and after) a learning episode, these students received a pattern of reinforcement which forces them to acquire less than adequate. Or the students,

BEST COPY AVAILABLE

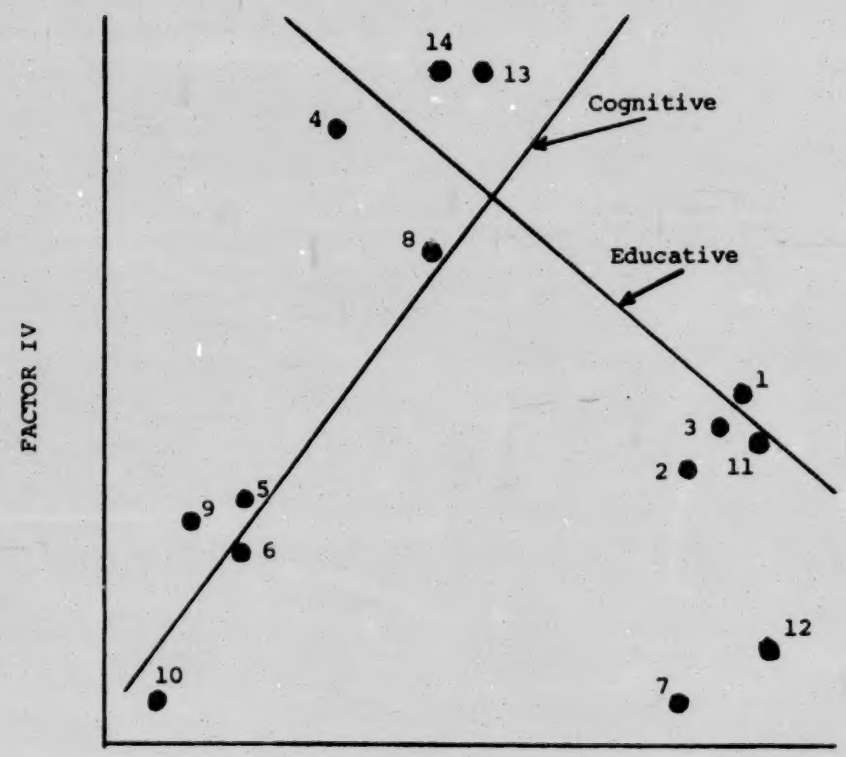


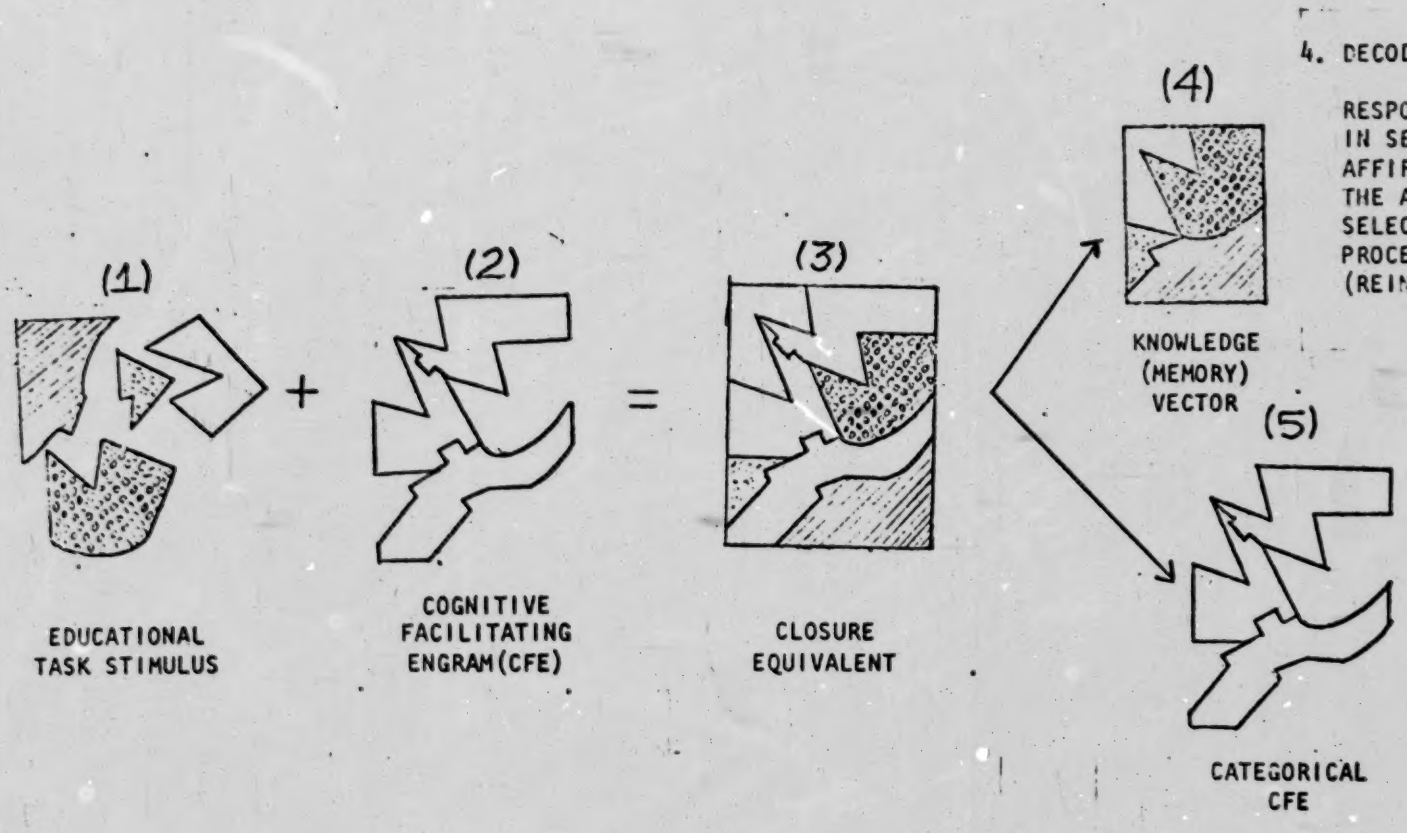
Figure 8. Factor clusters of six cognitive and eight educative skills (Iowa Tests of Basic Skills) - low achievers.

Variables: 1=R, 2=L-1, 3=W-2, 4=A-2, 5=Cf-2, 6=Cs-1, 7=Ma-2, 8=N-3, 9=P-3, 10=Ss-1, 11=V, 12=L-4, 13=W-3, 14=A-1.

not being aware of the importance of verbal oral, or symbolic discrimination, chose to ignore critical bits of information.

Whatever be the case, these inappropriate and/or inconsistent actions become woven into the fabric of their neuronal structure. And, since these inputs are not accurate, they have a debilatory effect on the cognitive functions of the children--in particular, the mechanisms which facilitate cognitive operations. Figure 9 (page 21) shows the mechanism and process of an essential neuronal structure: a cognitive facilitating engram (CFE). It should be remembered that a CFE is the culmination of a number of experiences which instructs the organism during the learning process. It (CFE) defines what information is to be expected, what pattern of neuronal activity will be established, and what the kind of cognitive processing will operate on the incoming information. In the figure we see that Operation #1 is an encoding function. Here the educational task sets forth a number and variety of stimuli. At Operation #2 the stimulated cognitive facilitating engram (CFE) (a) selects from the barrage of stimuli those which are appropriate for the accomplishment of the task and (b) initiates addition excitations to set the stage for the next operations. At Operations #3 the requisite bits of information have been assimulated and the corresponding cognitive processing mechanism/strategy has been employed to produce closure on the concept/activity. And, at the same time permits the learner to feel or view his completed actions in terms of his reality of the external world.

Once Operation #3 is completed, the learner moves to Operations #4 and #5 simultaneously. At Operation #4 the learner decodes his solution,



1. ENCODING:

   RECEIPT OF INFORMATION FROM EXTERNAL STIMULI IN COMBINATION WITH SUBSEQUENT INPUTS FROM INTERNAL SOURCES

2. COGNITIVE FACILITATION:

   THE USE OF A PRESCRIBED COGNITIVE TEMPLATE WHICH DETAILS THE INPUTS THAT ARE REQUIRED TO ACCOMPLISH A GIVEN TASK IN THE MOST EFFECTIVE AND EFFICIENT MANNER

3. INTERFACILITATION PRODUCT:

   THAT CONSTRUCT ACHIEVED THROUGH A COGNITIVE PROCESSING FUNCTION WHICH THE ORGANISM PERCEIVES TO HAVE DIRECT CORRESPONDENCE WITH THE CONCEPT OF THE EXTERNAL WORLD

4. DECODING:

   RESPONSE TO STIMULUS IN SEARCH FOR AFFIRMATION THAT THE AFFORMENTIONED SELECTION AND PROCESS WERE CORRECT (REINFORCEMENT)

5. REVERBERATION:

   RETENTION OF THE CONFIGURATION OF THE CFE AND COLLATERAL COGNITIVE FUNCTION UNTIL EITHER A SOLIDIFICATION, MODIFICATION, OR TERMINATION SIGNAL IS RECEIVED

Figure 9. Operation of a Cognitive Facilitating Engram in the learning process.

BEST COPY AVAILABLE

hoping to receive a positive reinforcement or verification, thereby, indicating that his processing was correct. Concurrently, the closure equivalent is stored (retained in memory). At Operation #5 the categorical CFE has already begun to repeat the same process--gathering appropriate bits of information and initializing the corresponding cognitive processing function. This repetitive operation is called "reverberation". And, the action is maintained to keep the learning process in the learners consciousness and to reinforce or firm up the memory trace (vector). The learner can stop the actions of a CFE for one of three reasons: (1) he receives either no or a negative reinforcement; (2) he believes that the mechanism has been firmly fixed and cataloqued; (3) he recognizes that either parts of or all of the mechanism should be modified. However, the learner retains the prerogative to modify the CFE with collateral cognitive syntheses at a later date.

Figure 10 (page 23) illustrates what probably happens in the case of high- and low-achievers or pupils with a learning disability. We see that pupils in both groups are exposed to the same educational task stimulus. However, their responses to the stimulus is different. When we look at the cognitive facilitating engrams (CFEs) of the groups, we see that their configuration are similar and that their CFEs have two components common--A and B. And that their other components (C and D), while supporting the general structure, are uniquely different. For example, D' of the low achievers has a sub-section which the D of the high achievers does not have. If we look closely at D', we can see that the protrusion of C' into D' is less than and of a different nature than that of C to D. Nevertheless, the cognitive processing activities of the different CFEs produce almost identical closure equivalents (gestalts having similar topographical properties).

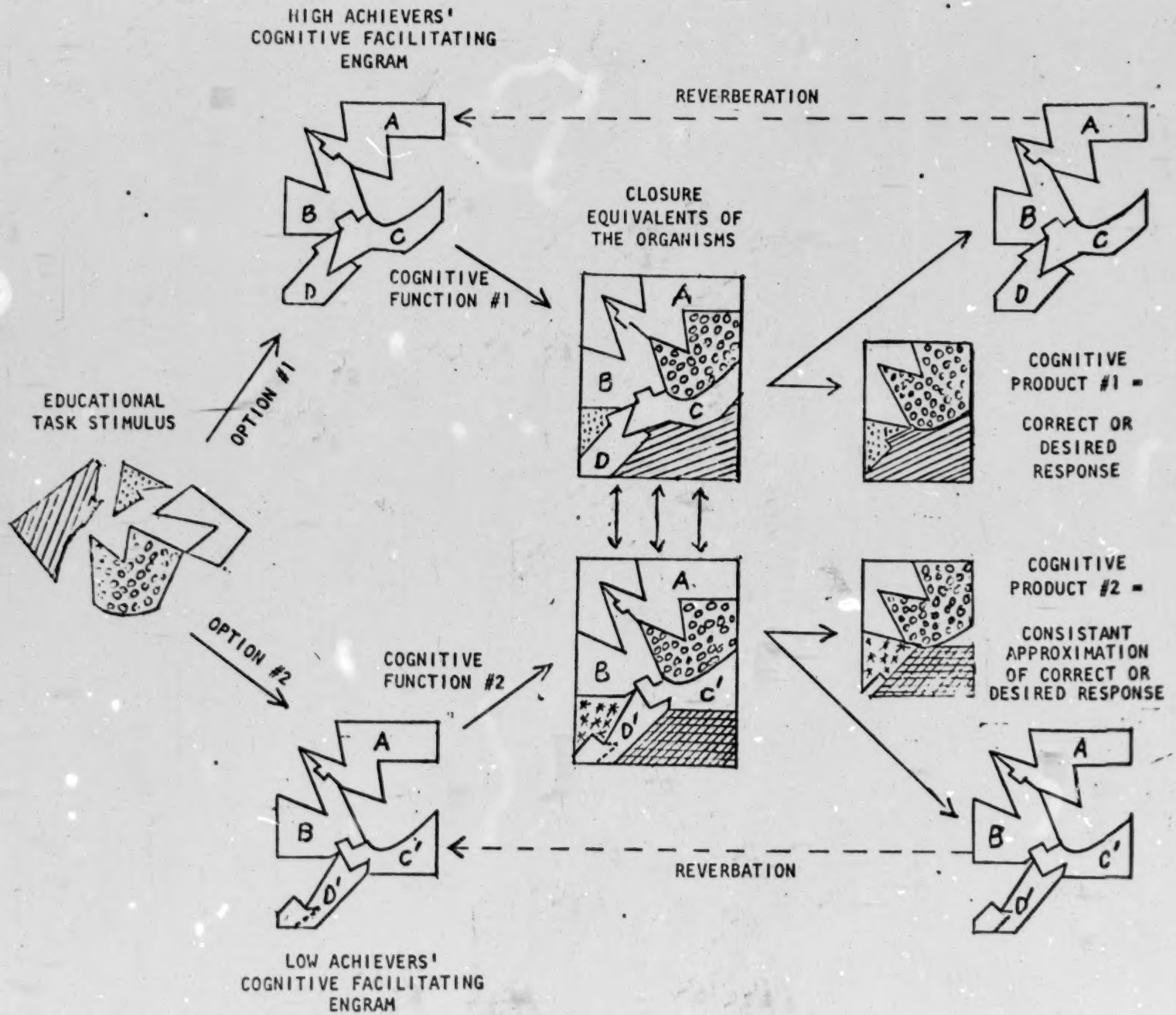


Figure 10. Cognitive mechanisms of high-and low-achieving students.

BEST COPY AVAILABLE

Up to this point it is difficult to ascertain which of the learners is not doing well. However, when we look at the cognitive products, we can see who is correct and what makes the products different. First, while the products (responses) are of the same general shape and have common components, the structures are different. Notice that there are two breaks or gaps in the low achievers' product. Initially, the existence of such gaps does not seem important in relation to the total product. However, with the context of an intermediate product, they become quite crucial. In the latter case, the gaps would definitely weaken the larger structure and make closure at the next level of integration more difficult.

Second, we see that the texture of the cognitive products are different. Two components of the low-achievers' product are approximations of the desired ingredients. Accordingly, the relative precision of the product, its conceptual content, will depend on how far the substitutes deviate from the desired components.

The third consideration is one which is not usually discussed. Acceptance and/or reinforcement of the low achievers' approximations do not help the learner. They cause serious problems. They (the approximations) cause the formulation of inappropriate CFEs; they distorts the reality of the learner (by causing him to create faulty identities or connections among the objects he is expected to manipulate); they increase the probability that the learner will fail.

Performance Engrams of High Achievers

Reading engram. These pupils understand the operations of the construct and the appropriate components--vocabulary and language usage skills. In the operation, the meaning of the verbal communicators (words) and the logics of

the structure (syntax) are comprehended to the extend that the operands (rules) can be applied in a systematic manner; thereby, increasing the effectiveness of their communication.

Arithmetic engram. These pupils understand the operations of the construct. Therefore, the rules (concepts) and operands (numerical symbols) can be combined or integrated to permit an understanding and following of the logical progression within the system.

Performance Engrams of Low Achievers

Reading engram. These pupils do not understand the operations of the construct. Therefore, they use a host of discrete or independent cognitive and educative abilities such as (a) coding functions, (b) absolute rules of grammar, (c) standardized or repetitive syntactical supports (i.e., guide words, italicized words), and (d) rememberances of known similarities. In the operation, all or a combination of those independent abilities which permit the extraction, formulation, comparison, and/or identification of information are combined and transmitted through any independent skill which has a logical operations' function. From this amalgum, that solution (communication) which appears to be most compatible is selected and transmitted.

Arithmetic engram. These pupils do not understand the operations of the construct. Therefore, discrete or independent cognitive and educative abilities are used. Primarily, those abilities having to do with coding, the recurrence of syntatical cues, and systematic comparisons. In the process must effort is directed toward the retention of syntatical structures, repeated comparisons, and the elimination of distractors. Formalized rules (concepts) are not used to any significant degree. The final product represents that approximation which

is most compatible within the logic of the derived, artificial context.

I cannot leave these considerations without speaking to the impact of social reinforcement systems (SRS) on general behavior and school achievement. SRS consist of those sociological forces (positive and negative) which influence the composition of the actions an individual takes when exposed to a social situation or when he feels that his internal security is threatened. The nature and pattern of reinforcements an individual receives cause him to establish a highly sensitive network of social responses which have the capacity to maintain his tranquility (Brown, 1970).

An individual exercises two status control variables: pseudostatic and flexible. Pseudostatic status variables are those which remain fairly constant under most conditions and which, after excitation, return to a predetermined level of existance (i.e., physiological condition, intellect). Flexible status variables are those which are in a continuous flux. They are unpredictable, easily modified, and remain stable only when a concerted effort is applied (i.e., emotion, self-esteem, peer status).

The dynamic interplay of these status-control variables have a direct, dynamic effect on the encoding of external stimuli and psychoneurological functions. Negative cues (-srs) cause an individual to initiate defensive (inhibitory) mechanisms. Subsequently, the individual causes the production of chemical substances which modify, alter, or scramble incoming stimuli do not initiate neuronal patterns which signal unpleasant consequences.

When such cues (-srs) occur in the presence of a learning situation, the defensive mechanism become associated with the accompanying cognitive facilitating engram (CFE). Obviously, since the need for internal stability (homeostasis) is always greater than the need to solve the contiguous learning situation, the

learning takes a secondary role. The unfortunate aspect of this situation is that when the perceived threat is no longer present, it is conjured-up whenever the learning episode is repeated. Naturally, the individual automatically moves to quiet the threat. Moreover, whatever knowledge or performance the individual might have acquired is never manifest.

IMPLICATIONS FOR CHILDREN EXHIBITING A LEARNING DISABILITY

As was stated previously, children exhibiting a learning disability are children who are not able, for a variety of reasons, to make the necessary connections between what they know and what the schools expect them to accomplish. The author purports that the cause could be either of three reasons: physiological, psychological, educational. Although a discussion of each follows, it is important to take a moment to describe what the mechanism of difficulty might be.

In Figure 11 (page 28) we see a diagrammatic representation of the general factors affecting school achievement. At one level, easily attainable evidence about the schooling ability of an individual exists: measures of intelligence, aptitude, and/or achievement ability (in the broadest sense). We also can acknowledge that at the next level, the previous variables play an important role. However, the new consideration is that the previous variables have only an indirect effect on the cognitive processing capability of the individual. It is postulated that previous knowledge (memory) and educational experiences are the major contributors in that they define the CFE that will be used. And, consequently, the parameters of the cognitive processing activity and the content of the response to the educational task.

The two other forces, physiological and psychological status, are also shown in the figure. But, notice that they are thought to effect the cognitive

BEST COPY AVAILABLE

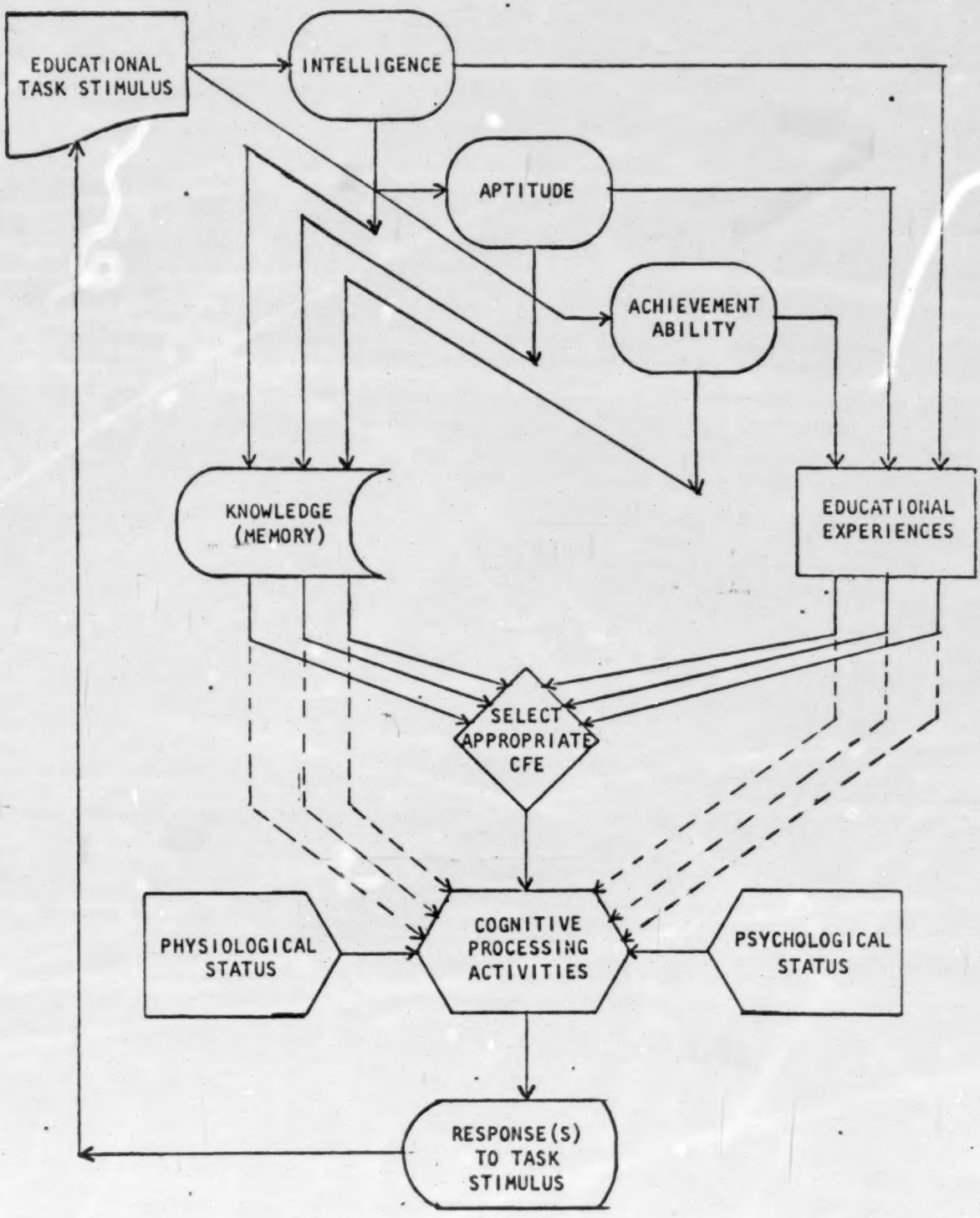


Fig. 11. Factors affecting the learning mechanisms of children exhibiting a learning disability.

processing activities. This means that the learner might have all of the qualities one might expect a learner to have, but be unable to perform properly because of the influences of the former control factors.

Factor 1. Physiological Constraints

Although much attention has been given to the hyperactivity of children exhibiting a learning disability, not much evidence that the increased level of energy were related to increased metabolism or uncontrolled activity of reticular cells. In either case the resolution of this constraint is not within the purview of educators. The best that the administrator of a school could do is to see to it (a) that his school had a sound lunch program and (b) that his school's nurse has developed a viable network for securing appropriate ancillary resources (i.e., hospitals, health clinics or agencies).

Factor 2. Psychological Constraints

The impact of psychological problem on the ability of learners to perform is well documented. Special mention is made here in response to the ability of such conditions to blot-out or interfere encoding and decoding processes of the learner. It is believed that such actions create parallel neuronal systems which vie for the attention of the learner and/or permit the alteration of neurochemical to the extent that previously formed chemical relationships are being constantly eroded.

Educators have two sources immediately available: counseling services and teacher behavior. Counselors could schedule regular meetings to try and isolate those school and home problems which contribute to the condition. They could also meet with parents and schedule additional psychological services.

Classroom teachers could receive additional training in human relations. In such a program, the teachers should learn more about themselves and how they

interact with other humans--especially children. They should become more familiar with the characteristics and needs of children exhibiting a learning disability. They should come to know the potential for achievement these children have and how to cope with their seemingly failures. Such an experience would surely improve the learning atmosphere of the classroom and improve the quality of reactions between the child and teacher, particularily during crisis situations.

Factor 3. Educational Constraints

Administering to these constraints is surely the responsibility of educators. For it is here where the contributions of the other services come find their home. Therefore, it is essential that the diagnosed problems and method(s) of treatment become couched in a program which foster their success. In other words, no generalized program could be acceptable. If a child is one whose impaired achievement is precipitated by physiological problems, his educational program and activities must be different from those of a child having psychological problems. Simply speaking, educational programs must have a high degree of concordance with the diagnosed needs.

RECOMMENDATIONS FOR INSTRUCTIONAL PROGRAMS

Although mathematics would indicate that the number of probable individual cases is astronomical, I believe that the most frequent cases would be relatively small. And, therefore, I offer a number of pertinent component consideration which could govern this finite group.

Instructional programs should emphasize the learning of concepts rather than facts. This would have the effect of helping the children reconstruct the constructs they had learned previously.

Instructional programs should stress mastery-learning. That is, continued teaching until the child will have demonstrated a complete knowledge of the subject/lesson taught. This has the effect of filling in gaps in information or operations the child might have acquired.

Instructional programs must begin at the readiness level of the children. This is stressed because the children, although seemingly being at a high verbal level, probably lack many of the underlying constructs of learning.

Instructional programs must stress problem solving skills. This procedure is recommended because it fosters the attainment of transfer skills and mechanisms--the ability to apply known skills and successes to new educational tasks.

Instructional programs must stress the use of fine visual-motor skills and coordination. Instructional programs must stress the use of alternative methods of instruction and planned reinforcements. These considerations are made to insure that each child might have a lesson taught in more than one way. And, that all children should be given encouragement and assurances that the work he is doing is acceptable--not every once-and-awhile, but on some consistent basis.

The six recommendations I have made are not new or original, and for these reasons they are probably overlooked for that "new" something "out-there". Nevertheless, let me conclude by saying that a child exhibiting a learning disability is not a child to be written off or researched ad infinitum. If you can accept the theory I am proposing or if you are willing to look at the field and synthesize the existing data, you will agree as I that now is the time to focus our attention and energy on the securing of practical, prescriptive services for these children. We cannot afford to give them less.

REFERENCES

Beritashvili, I.S. Concerning psychoneural activity of animals. In M.Cole and I.Maltzman (Eds.), A handbook of contemporary Soviet psychology. New York: Basic Books, 1969.

Bloom, B.S. (Ed.) Taxomony of educational objectives. Handbook I: cognitive domain. New York: McKay, 1966.

Brown, E.K. A descriptive follow-up survey of learning disability students reassigned to regular classrooms. Report #7429. School District of Philadelphia: Office of Research and Evaluation, 1974.

Brown, E.K. A sociopsychophysiological model for explaining the causal effect of social reinforcement system. Research in Education, ED 040 251, 1970.

Brown, E.K. Underachievement: a case of inefficient cognitive processing. Research in Education, ED 048 419, 1971.

Bruner, J.S. The process of education. New York: Vintage, 1960.

French, J.W., Ekstrom, R.B., and Price, L.A. Manual, Kit to Reference Tests for Cognitive Factors. (Revised) Princeton, N.J.: Educational Testing Service, 1963.

Guilford, J.P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Harlow, H.F. Learning sets and error factor theory. In S.Hoch (Ed.) Psychology: a study of science. Volume 2. New York: McGraw, 1959.

Hebb, D.O. The organization of behavior: a neuropsychological theory. New York: Wiley, 1949.

Hydén, H. and Egyhazi, E. Nuclear RNA changes of Nerve cells during a learning experiment in rats. Proc. Nat. Acad. Sci., 1962, 1366-73.

Krech, D., Rosenweig, M.R., and Bennett, E.L. Correlation between brain cholinesterage and brain weight within two strains of rats. American Journal of Physiology, 1959, 196, 31-32.

Luria, A.R. Human brain and psychological processes. New York. Harper, 1966.

Piaget, J. The origins of intelligence in children. New York: Internation Press, 1952.

Pribram, K.H. Memory and the organization of attention and intention. In V.P.Hall (Ed.), Brain function and learning. Berkeley, Calif.: U of California Press, 1967.

Scientific American. Altered states of awareness. San Francisco: Freeman & Company, 1972.

White, S.H. Evidence for a hierarchy arrangement of learning processes. In L.R.Lipsitt and C.C.Spiker (Eds.), Advances in child development and behavior. Volume 2. New York: Academic Press, 1965.

Teitelbaum, P. Sensory control of hypothalmic hyperphagia. Journal of Comparative Physiological Psychology, 1955, 48, 156-63.

APPENDIX

INSTRUMENTS

1. Six tests of cognitive ability were used in this study (French et al., 1963). These particular tests were selected because previous studies (in the citations) have indicated that the abilities measured by these tests are associated with learning performance. A brief description of each test follows.

Flexibility of Closure, Cf-2. The ability to keep one or more definite configurations in mind when making an identification of an object in spite of perceptual distractions. This also represents one's ability to allow only the preferred or appropriate images to emerge from a visual field by controlling or minimizing the effects or interferences of extraneous stimuli.

Speed of Closure, Cs-1. The ability to unify disparate perceptual fields into a single percept. This factor differs from Cf-2 in that the subject must construct the image rather than identify it within a distracting field. Speed of Closure is related to one's ability to (a) remember bits of unrelated material, (b) find figures, (c) make comparisons, and (d) carry out visual tasks.

Associative (Rote) Memory, Ma-1. The ability to remember bits of unrelated material. Tests requiring recall of items in isolation do not have a loading on this factor. Although there has been no clear demonstration yet, this factor appears to represent the ability to form and remember new associations quickly.

Numerical Facility, N-3. The ability to manipulate numbers in arithmetical operations rapidly. Tests involving memory for numbers, counting, plotting on graphs, and a host of other tasks load on this factor. Non-numerical tests having to do with coding have a moderate loading. Sometimes speed of reading and reading comprehension tests are related to Numerical Facility when this factor is considered to be a General Reasoning Dimension.

Visual Discrimination, P-3. A measure of one's speed in finding figures, making comparisons, and carrying out other very simple tasks involving visual perception. Subfactors have been defined as (a) speed of symbol discrimination (Cattell, U.I.T. #12), (b) speed of making comparisons, and (c) speed of form discrimination as in recognizing predetermined or novel configurations (Guilford, EFU or ESU).

Maze Tracing Speed, Ss-1. A measure of one's speed in visually exploring a wide or complicated spatial field. This ability involves the scanning of a field for openings, following paths with the eye, and quickly rejecting those paths presenting false leads. On some tests, this factor is termed "planning function." The level of planning required by these tests seems to be willingness to find a visually correct path. Others have interpreted this planning capacity as being somewhat analogous to rapidly scanning a printed page for comprehension.

2. The Iowa Tests of Basic Skills (ITBS) battery was given to measure the ability of the students to use specific skills associated with the educative processes of the schools. Only eight subtests were evaluated--a subtest assumed to be most closely associated with the attainment of reading and arithmetic performance.

Vocabulary (V). Purpose--to determine whether the students know the meanings of all words within a given item.

Reading (R). Purpose--to measure the student's skill in locating details, finding purposes, recognizing (literal) organizations, and making evaluations of written selections.

Total Language (L). In general, the language section is designed to detect language errors which more clearly differentiate between students who habitually use correct language and those who have not developed functional habits and correct use of the language. Spelling (L-1) items require the student to identify incorrectly spelled words. Sixteen possible error types are used, ranging from double letters to consonant substitution. Language Usage (L-4) measures the student's knowledge and use of appropriate word forms and correct grammatical constructions. Items discriminate between those students who know and use good grammar and those who know but do not use correct English.

Reading Graphs and Tables (W-2). Students are asked to obtain information from five different graphs or tables. Such presentations include traditional displays and pictographs.

Knowledge and Use of Reference Materials (W-3). The student's ability to deal with the parts of a book, the globe, current magazines, dictionary, encyclopedia, atlas, etc., is measured. Activities involve the use of the index, dictionary guide words, key words, alphabetizing words, using the dictionary for spelling, syllabification, accentuation, etc.

Arithmetic Concepts (A-1). The student's understanding of the logic of the computational process is tested where the emphases are on the understanding of numerical systems, of terms, processes, and operations, of geometric concepts, and of units of measurement.

Arithmetic Problem Solving (A-2). The student's computation skill is tested in a meaningful setting. His competence is tested in a functional setting with problems chosen to be challenging and practical. However, the major skill categories are the same as those for subtest A-1.